

seem to be due to the shock of pain. It is as if irritation of the digestive ends of the vagus led to irritative reflex, inhibitory impulses that brought the heart to a standstill. This state of affairs reminds one of nothing so much as surgical shock. What the underlying basis for surgical shock is we do not know. It seems an excellent idea, however, to have the analogous term, "medical shock," to apply to certain non-surgical cases, because this will stimulate the investigation of both conditions, so as to solve the important problems they involve.

DR. C. A. KELSEY, Minneapolis, Minn.—By whatever term we call it, surgical shock, heart failure, or any other term, we all experience the same anxiety when we are confronted with the condition. During the reading of this excellent paper one thought came to me which I would like to discuss here. In diseased conditions where heart failure is liable to occur, is it the wisest plan to fortify the patient against its occurrence, or shall we reserve our agents until the critical moment comes and they are demanded? I have sometimes thought that we make a mistake by crowding the hypodermic injections of strychnin, or other powerful heart tonics, in cases where it does not seem to be positively indicated. I have in mind a case of diphtheria in a child occurring not long since, in which the consultant advised beginning and continuing the use of heart stimulants by the hypodermic method in order to anticipate heart failure. That plan was pursued, the nurses were provided with the hypodermic syringes, and they continued to use the injections. But, when the critical point did come and the heart failed, the heart then refused to respond to stimulation and the patient died. The point I want to raise is this: Is there not a possibility of making a mistake in commencing the heart stimulants before they are positively indicated and thus get the system so accustomed to the stimulants that the heart fails to respond at the critical moment? A man in a race does not use the spur at the beginning, but at the proper moment; if he did use it at the beginning the horse would fail to respond to it when the proper time came.

DR. GEORGE W. WEBSTER, Chicago—Whether we employ the term heart failure, or weak heart, or surgical shock, or medical shock, we should, all of us, be ready, at all times, to recognize the condition. I believe there is no one point on which there is less clearness of conception than in regard to this matter of failure of weak heart, and the conditions which bring about a weak heart. I know that there are many physicians who, when they examine the heart with a stethoscope for the first time, and find no murmur and no apparent intrinsic cause for the heart giving out, pronounce it sound. We should remember that a weak heart may be brought about by overwork due to both intrinsic and extrinsic causes; it may be due to valvular lesion; or the right side may be overworked from causes in the pulmonary circulation, and the like; or the left heart may be overworked from systemic conditions, as a general arterial sclerosis; the heart may fail from toxemia due to many causes, such as alcoholism, gout, syphilis, or from the toxins produced by various acute infections. There are many of these toxins which influence the heart muscle directly, and both the intrinsic and extrinsic nervous mechanism of the heart. Again, the heart may fail from failure of nutrition, which may be due to disease of the coronary arteries, primary or secondary anemias, or reflex causes.

I remember an experience that I had as a medical student about twenty years ago. We had a rabbit upon which we were going to experiment, and that animal was actually scared to death. The conditions found were these: The heart was found to be absolutely bloodless and the abdominal veins were enormously distended with blood; in other words, the animal bled to death into his own veins, the veins presided over by the splanchnic nerves. There was a failure of the heart from the nervous influence. Mental emotion may of itself be sufficient to cause a dilatation in the splanchnic area, so lowering the arterial pressure, causing the heart to fail. If we use the term heart failure we should remember that it is merely a convenience for classifying, not in any definite way, but to cover up a large number of things where we were unable to make an accurate diagnosis.

DR. R. C. NEWTON, Montclair, N. J.—I agree with the last speaker in regard to the inadvisability of calling conditions "medical shock" which are due to toxemia, to weakness, to overstraining of heart muscle, and perhaps to overdrugging. I think the term is confusing. If we use this term it will convey to the laity the impression that the physician has done something or allowed something to occur to the patient that could have been prevented. I agree with Dr. Osborne's explanation of the condition, and think that his paper describes vividly a pathological state with which we are all more or less familiar. The paper is interesting and instructive; but it seems to me that if a new name be needed for this condition a better one might be found than the one the Doctor suggests.

DR. OSBORNE, closing—I have but little to add. I do not feel that I ought to back up the term too strongly, yet I think we should have some other term to denote this condition. Heart failure is an opprobrium. If we amputate a man's leg and the man dies we should not say that he died from the amputation of that leg. The way to treat medical shock is to prevent it in much the same way that we prevent surgical shock; there is a prevention for medical shock as there is for surgical shock. I think the term medical shock will help us in making up our statistics.

THE SPREAD OF TUBERCULOSIS BY COUGHING.*

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PHILADELPHIA.

The general opinion held by the medical profession at large has been that tuberculosis is disseminated chiefly by sputum, pus from tuberculous ulcers and sinuses, and from the dejecta of the bowel in persons or in animals suffering from tuberculous enteritis; these substances, from whatever source, becoming dry and later pulverized; they, together with their tubercle bacilli, are carried about by the currents of air. Such dust is commonly agitated by sweeping and dusting of carpets, rugs and furniture in rooms previously occupied by tuberculous patients. Indeed, the investigations of Cornet¹ go far to corroborate this popular belief.

Cornet showed that dried sputum—dust—remained dangerous for months. He collected dust from the floors, walls and furniture of rooms previously occupied by persons suffering from pulmonary tuberculosis in various prisons, hospitals, asylums, and private dwellings, and, inoculating animals with such dusts, he determined the presence of virulent tubercle bacilli. Of the 118 samples of dust collected from the rooms of phthisical hospital patients, 40 were found capable of producing tuberculosis in animals by inoculation. Dust collected from 21 medical wards was also proved to contain living virulent bacilli in 15 of such samples. In one instance the dust was found to be infective six weeks after the death of the patient. Cornet,² to prove further the infectiousness of such dust, shook in a room a carpet infected with tuberculous sputum dust, and forty-eight hours later placed in this room 48 healthy guinea-pigs, of which number 46 developed extensive lesions of tuberculosis. Attempts to infect animals by the blowing of tuberculous sputum dust was attended with negative results.

Heron, in the City of London Hospital, and Hance,³ in the Adirondack Cottage Sanitarium, do not find tubercle bacilli common in the dust of these institutions,

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being found in but 1 of the 17 specimens studied. These and other investigators have shown that the air and dust of certain institutions and dwellings occupied by consumptives were contaminated with tubercle bacilli, and this, in connection with the clinical fact that healthy persons who occupied such places were likely to develop tuberculosis, furnished additional support to the belief that infection took place through the respiratory tract; and that the sputum was the chief source of danger, seemed evident.

The swallowing of bacilli from the mouth or upper respiratory tract has long been regarded as a dangerous procedure, as has also been the feeding of infants on milk from tuberculous cows, as shown by Cornet.⁴ Klebs, Gerlach, and others have shown that milk from tuberculous cows is capable of producing the disease in animals fed upon such milk. Further, it has been shown by Klebs, Parrot, Aufrecht, Chauveau⁵ and other observers, that if the sputum from consumptives be incorporated with the food for susceptible animals, such animals develop tuberculosis. It will suffice to make mere mention of direct infection, since such instances are comparatively rare, and certainly occupy a small percentage of all tuberculous processes.

Flugge⁶ was probably the first to consider the question of the dissemination of tubercle bacilli by coughing. "It is not at all proved that inhalation of dried sputum dust can produce tuberculosis in healthy men. If there is infection in healthy men this can be produced either by contact or inhalation, not so much by dried dust as by sputum which is spread in the air in finest drops in coughing." This spray composed of droplets containing tubercle bacilli may float in the air for some time, and be carried by fine currents about the room. Flugge regards this spray to be the true cause of infection, and to support this view he compares the results obtained by spraying dried sputum and moist sputum into cages occupied by experimental animals, in which cases the latter only gives positive results. He calls attention to persons who cough with closed lips, and to those who allow the mouth to remain open while coughing; of these, the latter class only is regarded as dangerous, and this danger is obviated by the avoidance of hard coughing, or the application of a handkerchief to the mouth while coughing.

Laschtschenko continued Flugge's experiments by demonstrating that this spray containing bacteria was produced by loud talking, coughing and sneezing. For this purpose the bacillus prodigiosus was added to the mouth fluids, after which agar-agar plates were exposed in various portions of the room, and in this way the bacilli were recovered at a distance of ten meters from the patient after hard coughing. Tuberculous patients were permitted to cough into a glass box, in a distant portion of which a bowl containing distilled water was placed. This water, after being exposed to the spray emitted by an indefinite number of coughs, often contained tubercle bacilli. Glass plates were exposed one-half to one meter (19.75 to 39.50 inches) distant from the patient's mouth, when he was directed to cough against them, and by the staining of such plates tubercle bacilli were occasionally found.

J. J. Curry,⁷ at the suggestion of Prof. Edwin Klebs, studied 12 cases of pulmonary tuberculosis, in all of which the sputum contained tubercle bacilli. Examination of the mouth fluids at various hours during the day, by staining, resulted in the detection of tubercle bacilli in 9 of the cases; bacilli were most plentiful

during the morning hours and after a paroxysm of coughing. In 6 of these 9 positive cases, it was extremely difficult to demonstrate the bacilli in the mouth fluids. Glass plates were suspended before the patients, at distances of from one to three feet, during coughing. These plates presented two varieties of spray, one composed of very fine drops, the other of larger drops, one to five millimeters in diameter. In these larger drops were the tubercle bacilli found, 28 being the largest number noted in the large drops. By the staining of these plates Curry obtained positive results in 50 per cent. of cases.

W. Goldie,⁸ assisted by Dr. Southerland and Mr. Young, repeated the experiments of Flugge, his assistant Laschtschenko, and Curry. They confirm the statements made by Laschtschenko by using an emulsion containing the bacillus prodigiosus in the mouth; they found that most colonies developed on plates exposed ten feet distant from the patient and at an elevation of five feet, during coughing, these findings being influenced by vigorous coughing and by currents of air. It was further shown that plates were infected at a distance of ten feet by laughing, six feet by loud talking, three feet by ordinary talking, while deep breathing seldom infected plates, even at a few inches from the mouth. During ordinary talking for two minutes, 90 droplets fell on a four-inch glass plate placed eight inches from the speaker, each droplet containing bacteria. Clean glass plates were held six inches from the mouths of phthisical patients while coughing, for twenty-four hours, and when stained by carbol-fuchsin gave positive results, as follows: 60 per cent. of all cases; 60 per cent. where cough was accompanied by expectoration; 33 1-3 per cent. where cough was not accompanied by expectoration; 28 per cent. where plates were used during a single coughing in the morning, and 14 per cent. when used during the evening. The droplets varied from a few (50 microns) to many millimeters in diameter, and were composed largely of thick mucus and leucocytes. Single fields, under the oil-immersion lens, were seen to display from 125 to 200 tubercle bacilli. The mouth fluids were rarely found to contain bacilli, and only when the sputum was noted to be profuse or liquid.

M. P. Ravenel⁹ collected, on pieces of soft pine wood, the spray thrown out by tuberculous cows in coughing, by placing the wood near the bottom of a nose-bag which the animal wore for a variable time. In cases where only a small amount of spray had collected, this, when transferred to cover-glasses and stained, was always found rich in tubercle bacilli, and it was possible to demonstrate the bacilli in the spray from every tuberculous animal studied. Of 22 guinea-pigs inoculated with portions of this spray, 11 became tuberculous. Guinea-pigs were exposed to the breath of tuberculous cows, but in no instance did infection occur. Note-worthy is it that these cows were not all in the later stages of the disease, one living for more than two years after the experiments were made.

The causes which prompted me to investigate the degree with which tubercle bacilli are disseminated by coughing were as follows: 1, from the mouth of an inmate of the Philadelphia Hospital who presented the conditions common to advanced phthisis, I noticed that fine droplets of sputum were ejected with each cough, and 2, I observed that coughing was often excited by eating, not only in patients confined to their beds, but also in those able to walk to the dining-room. It ap-

peared to me that if this fine spray contained tubercle bacilli, when produced in such quantities in the dining-room where it must of necessity fall upon the food to be eaten by others, as well as those producing such spray, furnished a potent factor in the dissemination of tuberculosis, and possibly explained why patients in the early stage of the disease did not do well in this institution, where every possible attention is given to ventilation, light, and the disinfection of sputum.

METHOD OF COLLECTING SPRAY.

This was accomplished by means of a mask (Figs. 1 and 2). It was made from German silver wire, one piece of which is molded to fit the face, resting on the nose, cheeks and chin. To obviate any irritation to the patient, this portion was covered by a piece of rubber tubing. Suspended from this wire is a second oblong portion provided with two lateral grooves, which serve to accommodate two microscope slides. When the mask



is in position the slides are held directly in front of the mouth and nose, at a point three inches distant from the lips. The mask is held in position by an elastic band which passes above the ears and over the occiput.

Patients were allowed to wear the mask with the clean slides in position for from one to one and a half hours, during the day when they were apt to cough least and were instructed to remove it during a paroxysm of coughing. It was never worn during the morning or evening; the object being not to collect on the slide the spray produced by vigorous coughing, which had already been studied, but to determine whether or not consumptives emitted a fine spray, when talking, laughing, clearing of throat or by their characteristic hacking, that was in any way dangerous to the health of their associates.

Fifty patients, 34 males and 16 females, all of which presented unquestionable evidence of either pulmonary or laryngeal tuberculosis and in whose sputa tubercle

bacilli had been found, were made to wear the mask as above described.

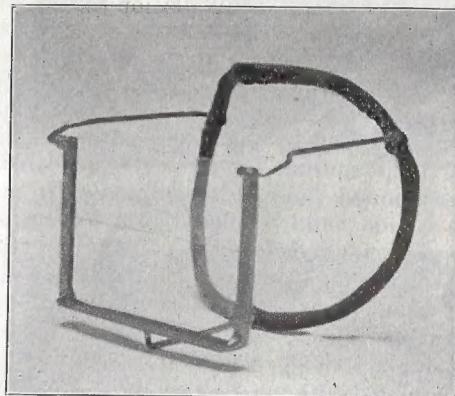
NAKED EYE APPEARANCE OF SPRAY.

This varied greatly and since patients were cautioned not to encourage coughing, no satisfactory explanation for such changes was noted. Certain slides displayed many droplets, varying from the size of a pin's point to that of its head. Others showed few droplets, while a third variety presented an evenly-spread film, very thin, covering the entire slide and seldom showing any distinct droplets.

MICROSCOPIC STUDY.

Specimens were fixed and stained by carbol-fuchsin and Gabbett's acid blue solution. Of the specimens collected from 50 patients, those from 49 were found to contain bacteria—the diplococcus and the streptococcus being the most constant, yet bacilli and clusters of cocci were not unusual. A single minute droplet often contained organisms of each class.

Of these 50 specimens, 38 were found to contain tubercle bacilli in variable numbers, four to six bacilli being the smallest number found in any specimen, and many of the specimens, under a $1/12$ oil-immersion lens, showed fields of bacilli too numerous to be counted. In fully one-third of the positive cases the bacilli were



very numerous. In one of the specimens where I hunted for fully one hour and passed the specimen as one not containing tubercle bacilli, Dr. W. J. Hawke, resident pathologist, in studying this slide later, found a droplet containing more than forty bacilli. I am further indebted to Dr. Hawke for his untiring interest and valuable assistance rendered.

Among other findings were large and small squamous epithelium and occasionally very small epithelial cells more or less intimately connected with thick mucus and leucocytes. The tubercle bacilli were commonly associated with these elements, but were occasionally found singly or a number of bacilli without any other elements in the field.

CONDITIONS INFLUENCING THE SPRAY.

From patients showing tubercular laryngitis and from those who talked loudly, or who were frequently clearing their throats, the most spray was found. In patients very weak, speaking only in a whisper, scarcely any spray collected on the slide and this seldom contained bacilli. Men wearing heavy mustaches ejected no spray on the slide until after the mustache was held from falling over the mouth. Coughing with the mouth open must necessarily favor the production of the spray.

Of the 12 negative cases, these explanations are

given: Sputum from 3 such patients contained only few bacilli and these were not found until after several examinations, none being found at the time when the specimen slides were collected. Another showed no bacilli in his sputum, yet autopsy revealed cavity formation. Three were extremely weak and did not talk while wearing the mask. The remaining 5 presented marked sprays containing many bacteria; yet careful examination failed to reveal the presence of tubercle bacilli.

The detection of the bacilli in these fine droplets of the spray was greatly facilitated by the use of a low power lens for the purpose of locating such droplets; after which a 1/12 oil-immersion lens was used. Droplets not perceptible to the naked eye were often found in this manner, and such minute particles not infrequently contained tubercle bacilli; at times they were present in great numbers. By the employment of these methods, it can be stated with safety that the finding of tubercle bacilli in the spray emitted by consumptives, during the act of coughing, sneezing, laughing, and talking, is not attended with greater difficulties than is the finding of the bacilli in the sputum of patients early during the course of the disease.

VALUES IN DIAGNOSIS.

These are doubtless limited. However, from the extreme difficulty one always meets in eliciting satisfactory physical signs from the chest examinations of the insane, and since we are seldom able to collect the sputum from such patients, it would appear that if they be carefully guarded by the attendants, this method of collecting their sputum for clinical study should have at least a limited field of usefulness. In nearly all instances a slide could be placed in a forceps and then held by an attendant before the patient's mouth during one or more vigorous coughs. In one instance, that of a colored female, aged 19, few bacilli were found after wearing the mask for one and a half hours, during which time she did not cough, while the spray from a single cough during a paroxysm showed many bacilli. Where the mask was worn for ten minutes during such periods great numbers of bacilli were found.

Children, likewise, seldom expectorate and a mask could readily be adjusted to the face of any child, and by carefully instructing the nurse, specimens could be collected during the acts of coughing or crying. This, as well as its value in the clinical study of the insane, must be further tried, and estimated only from the results obtained.

HYGIENE.

Now that it is shown that the secretions of the mouth and respiratory tract are atomized and given off in the form of a fine spray, in both health and disease, and that this spray contains bacteria and other cellular elements known to be common to such secretions, it is reasonably fair to suppose that many other diseases are conveyed by this medium, and that the work accomplished through the study of consumptives is but a step in a direction which bids fair to modify, in a measure at least, the hygiene of infection. Conditions affecting these organs and consequently their secretions must of necessity be spread in this way; especially is this true of diphtheria, tonsillitis, and possibly other conditions, the etiology of which is not definitely known, such as smallpox, measles, scarlet fever, whooping cough, mumps, etc. It further furnishes additional cause for the rigid disinfection, now universally carried

out, in connection with all cases known to be infectious in character.

Droplets alighting on clothing must serve as a favorable means to convey disease from house to house; and that man may become infected by the spray thrown off by horses, cows, and other domestic animals suffering from glanders, tuberculosis, influenza and similar afflictions, appears highly probable.

SURGICAL VALUE.

To repeat, "experiments show that during ordinary talking for two minutes, ninety droplets may fall in a four-inch circle at a distance of eight inches, each of these droplets containing from dozens to thousands of bacteria." (Goldie). At first this would tend to convey the impression that the danger of infecting open wounds during an operation by the sprays produced by the talking of the surgeon or any of his assistants is extremely great, and this would doubtless be true where any person assisting in the operation is suffering from either an acute or chronic infection of the mouth, throat, or respiratory tract. A fact ever to be borne in mind is, that in health this spray may contain great numbers of bacteria; yet few, if any, such organisms possess the properties necessary to infect man, even when introduced into an open wound. The advisability of all persons being provided with a mask of gauze on entering the operating room, to prevent all possibility of their contaminating the air of the room, would appear from a bacteriologic standpoint to be a rational procedure; yet before this precaution can be urged, it, too, must be tried by the surgeon, and shown to lessen the number of cases of infection for which at present no ascribable cause is given.

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TREATMENT OF CERTAIN FORMS OF CANCER BY THE X-RAYS.

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It is well recognized that cancer is on the increase, and reliable statistics made in various countries and extending over periods of years prove that the rapidity of this increase is surprisingly great. Any method of successful treatment, even though it may be limited in its application to certain forms of this disease, will prove to be a great boon to humanity. Further, as is natural with the advance in the application of science to medicine, the opportunities for the irregular practitioner will be curtailed.

Although I shall refer to but few of the cases I have treated, I hope to present enough to have the reader share my opinion, namely, that in the *x*-rays we have an agent which causes superficial external forms of cancer to heal; and this may be done without pain to the patient.

From the standpoint of treatment by the *x*-rays, cancers may be divided according to their position into external and internal forms. Of the internal cancers